DOCUMENT RESUME

ED 039 775 56 EM 008 111

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TITLE Instructional Technology and the Less Affluent College.
INSTITUTION Academy for Educational Development, Inc., Washington, D.C.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-8-0571
PUB DATE [70]
NOTE 22p.; This is one of the support papers for "To Improve Learning; a Report to the President and the Congress of the United States by the Commission on Instructional Technology", ED 034 905

EDRS PRICE EDRS Price MF-$0.25 HC-$1.20
DESCRIPTORS *Colleges, *Educational Finance, *Instructional Media, *Instructional Technology, Television

ABSTRACT

The question of whether instructional technology is within the reach of the less affluent college leads to the following observations and conclusions: Instructional technology will not, cannot, and probably should not reduce the already meager budgets of the less affluent college. Technology has produced very little change in the average level of student achievement. Factors that impede the growth of technology in higher education include faculty opposition and some student lack of interest and, sometimes, opposition. There are, however, instances where technology has been integrated, with significant success, with education. Integration depends upon precise and comprehensive application. An analysis of the successful cases suggests measures that will insure full integration. The feasibility of such measures--detailed in this paper--leads to the final conclusion that the smaller and less affluent educational institutions no longer need feel excluded from the technological fraternity. (Author/GO)

Instructional Technology and the Less Affluent College

by Chester M. Alter*

One of the serious questions that has been raised within the total context of the Commission's study has been, "what is the potential of technological instruction for the less affluent college?" The purpose of this paper is to throw some light on this question, to point out some of the findings of previous research, to call attention to some of the special problems of the less affluent college with respect to the use of technological methods of teaching and learning and to suggest some possible ways of overcoming present barriers to further utilization of modern methods and instruments of communication of ideas.

No effort is made here to catalogue or to evaluate the long list of technological approaches to instruction in general. On the other hand we have undertaken to focus attention on the special potentials and problems which arise in a very practical way when these well-known methods or instruments are suggested or applied for the salvation or enhancement of the work of the small and less affluent college.

The obvious question will be asked: "What is the 'less affluent' college?" "Shouldn't all small colleges be placed in this category?" What we have in mind in this differentiated category is that group of colleges that might have from five hundred to fifteen hundred students and total annual operating budgets of the order of perhaps one or two million dollars. In institutions of this kind we find one common characteristic; namely, very little flexibility either in terms of finance or in personnel. Some will say that in both these areas, the operating level is at an irreducible minimum and therefore there is little room for investment in modern equipment or specialized personnel even though

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theoretically such an investment might reduce instructional costs or enhance instructional and learning quality.

Let us now look realistically at these two factors, cost and quality, since these are the two considerations that inevitably must justify the introduction of new approaches to the accomplishment of the objectives of any college.

Despite substantial investments in equipment and massive support of experiment, research and production, technology has still had very little impact on higher education in America. In the field of instructional television, for example, there are more than 1000 closed circuit systems in educational institutions, about a quarter in elementary and secondary schools, a quarter in specialized schools and a half in colleges or universities. Yet, as Jack McBride, an expert in ITV recently said, "If something happened tomorrow to wipe out all instructional TV American schools and colleges would hardly know it was gone."[1] The same observation can be made about the impact of teaching machines, audio-visual services or instructional films. Even in our largest, most affluent institutions, where millions have been invested in computers, closed-circuit television systems and a vast array of audio-visual devices, the relationship to college instruction remains sporadic and peripheral. In smaller institutions, with restricted funds and staff, the impact of technology has been even less.

This state of affairs does not stem from any lack of interest among college administrators or trustees. On the contrary, many top people in higher education have expressed keen interest in technology as a hope for coping with their perennial problems of rising enrollments and costs.

Nor have proponents been lacking among faculty members in schools of education, some of whom believe deeply in technology's capabilities for improving the quality of instruction and the rate of learning in our colleges. The two cases, one for technology as a means of reducing costs, the other as a means of improving instruction, can be generally summarized as follows:

1. Reduction of costs. Media can perform many of the functions now performed by live instructors, and/or can extend those functions to more students. By means of television a single lesson can be conveyed to an unlimited number of classes; through video tape, lessons can be recorded and repeated at will; through films, concepts can be learned without using faculty time for explanation; through computers, programmed dialogues can be exchanged without a teacher having to be directly involved. By broadcast television, instructional fixed service transmission or closed circuits to dormitories, classroom space requirements can be reduced, thus reducing costs for building construction and maintenance. Applied properly, and on a broad enough scale, investment in technology can soon be recaptured by possible savings in salaries and classroom facilities.

In America pupil/teacher ratios have been in almost uninterrupted decline throughout the 20th century while teacher salaries have recently risen to an accelerated rate. Technology is cited as one means of reversing this trend, by increasing the productivity of academic labor in the same way as it has increased productivity of industrial labor. A century ago American industry was spending about 75% of its capital for buildings and 25% for equipment. Education was doing the same. Today industry has reversed that ratio spending about 25% for buildings and 75% for equipment. Education's ratio remains exactly where it was a hundred

years ago, a labor-intensive enterprise, as Sorenson and McCusker point out, "with quality labor in short supply, relatively expensive, and comparatively unspecialized."[2] More than 53% of education's budget goes to "costs of instruction," and of those costs some 90% are for instructional staff. Technology, say its economic proponents, can and must be used in education, as it has been in industry, to increase efficiency and reduce labor costs. However, it is obvious that such per unit cost reduction might not be as applicable where the number of students that must be taught are quite small as in the case in the small, less affluent college.

2. Improvement of Instruction. Most of the arguments for technology's potential as a means of improving instruction rest on the "master teacher" concept. Through television the talents of great teachers can be recorded for all time and for all student populations. Outstanding teachers in all fields can be shared by all institutions and in those smaller institutions, unable to offer a wide range of courses, can provide virtually an unlimited curriculum. Films, teaching machines and radio, while not providing the "great personality" dimension that television offers, can still provide instruction in areas that otherwise would be out of reach.

Further, say the technological enthusiasts, the media tend to exert pressure on teachers to do their jobs better, to spend more time in preparation, to eschew digressions and discursions, to organize their material more effectively, to use more visual materials to reinforce their lectures and demonstrations. And the media offer, too, a means of improving many kinds of communication: They can magnify small objects or reduce large ones for more meaningful conceptualization, they can reproduce events and

relate them with abstractions, they can manipulate time and space, integrate concepts and things, give every student "a front row seat" in the classroom or lecture hall.

All these arguments are readily supported by evidence. All of these advantages are at least latent in mediated instruction. None of them, however, implies any fundamental change in the essential processes or methodologies of conventional instruction. They propose only an extension of those processes and methodologies to more students in, for some cases, a possibly more effective way.

The more revolutionary technologists maintain that technology can transform, not merely extend, our traditional methods of instruction. They point to some of the faculty assumptions on which classroom instruction is based . . . that what is said by a professor is necessarily absorbed by a student. By the right use of media, they say, we can escape the lockstep of the classroom, individualize the learning process, permit each student to learn at his own pace a body of material that he can to some extent adapt to his own peculiar needs. In this context a whole new educational pattern is implied, emphasizing the individual and largely independent use of media by students . . . computer-aided instruction, single concept films, slides, tapes and films available to each student as books are, when and as he needs them.

Better instruction at less cost . . . this is the promise held out by the supporters of a technological revolution in education. With such rich rewards in view, one wonders why technology has not swept through our institutions of higher education . . . particularly those smaller schools, less richly endowed with superior scholars and abundant funds.

One wonders why our new institutions . . . notably our vocational schools and community colleges . . . are not being constructed on an entirely new plan with technical installation playing a central part. To answer that question we must turn our attention to some of the flies in the technological ointment.

I. PROBLEMS AND PITFALLS

How successful have the media actually been in reducing costs for higher education? Bruce Biddle and Peter Rossi (1966) believe that ". . . the adoption of the newer media will not lead to significant savings (as claimed) in the overall cost of education. To save money with the use of media requires radical shifts in educational roles; for instance the teaching of large groups of students using television as a replacement for many teachers. It seems to us more likely that media will be used for upgrading the general quality of education, and that educational costs will continue to rise."[3] The small, less affluent college simply does not have "large groups of students."

Furthermore it would be difficult to find anyone involved in the operation of this type of college who seriously wants to "reduce the cost" of education in his college. Of course, one would have to ask what is meant by "cost" but to most of us this means expenditures for carrying out the educational mission of the college. In the public mind as well as the image held by most faculty members "education" is identified with "teaching." Somewhere along the line we have developed the myth that, in terms of process, education is almost synonymous with "teaching" rather than with "learning." The teacher is the key to teaching; therefore, the whole emphasis in education is on the teacher and the teaching process. This we call instruction. It is no accident that your Commission is called A Commission on Instructional Technology. No one would have thought about calling it A Commission on Learning Technology.

With this kind of identification of education with teaching and teaching with the teacher it is not surprising that no one, and particularly the teacher, wants to reduce the cost of "education." In the

non-affluent college where there is thought to be already a minimum of teachers it is unlikely that there will be great effort to reduce the cost of "education" (really, cost of teaching) even though it might rationally be shown possible to reduce the cost of "learning" by the introduction of new tools.

Costs of instructional equipment run the gamut from a few dollars for a simple programmed learning sequence to over a million for some television stations or computers. In between are slide projectors ($40 to $1000), overhead projectors ($120 to $400), 8mm cartridge projectors ($90 to $500) 16mm projectors ($500 to $2300), video tape records ($100 to $70,000) and television production facilities ($5000 to $500,000). The less expensive devices are valuable instructional tools but are useful primarily as adjuncts to the teacher, not in any sense a replacement for him. Their value as means of reducing instructional costs is, therefore virtually nil. More sophisticated equipment requires not only large capital outlays, but substantial operating expenses as well, for operating personnel and maintenance. Millions of dollars worth of expensive equipment is languishing in the basements of academe because there was no one on the upper floors capable of using it. Further, the costs of programming the more complex media are formidable, when rental or purchase of computer programs, video tapes, films, etc. are included.

Unless ample provision is made to support all the elements of mediated instruction . . . effective equipment, skilled operation and maintenance, quality programming . . . no design for instructional technology can bring success.

So we conclude that so-called instructional technology will not, cannot, and probably should not reduce the already meager educational budgets of non-affluent colleges of the nation.

How successful have the media actually been in improving instruction or, more important, in improving learning.

A vast amount of research has been done to compare the achievement of media-taught students with the achievement of students taught by conventional methods. The great bulk of this research has been focused on instructional television. Wilbur Schramm, summarizing that research in 1962, asserted that ". . . employing the usual tests that schools use to measure the progress of their students, we can say with considerable confidence that in 65% of a very large number of comparisons between televised and classroom teaching, there is no significant difference. In 21%, students learned significantly more, in 14% they learned significantly less, from television."[4]

In general, however, television has been less effective at the college level than at the elementary and secondary levels. Wilbur McKeachie, referring to closed circuit TV in higher education (1966) writes: "It seems safe to conclude that television instruction is inferior to classroom lectures in communicating information, developing critical thinking, changing attitudes, and arousing interest in a subject, but that this inferiority is probably not great." He adds that it has been "more effective in science and engineering courses than in social sciences and humanities courses."[5] On the other side of the coin, television has been successfully used at the U.S. Air Force Academy to improve and accelerate instruction in aerodynamics and at the University of Denver to increase dramatically the amount and complexity of material covered in an Introduction to Psychology course.

In answer to the question as to television's success to date in improving instruction, we can only answer that in some cases it has succeeded, but in such cases it has not produced any overall saving in instructional expense. In the majority of cases, instructional television has produced very little change in the average level of student achievement.

What factors tend to impede the growth of instructional technology in higher education?

Success stories and research findings notwithstanding, instructional technology is regarded by the majority of college faculties and students with suspicion, and sometimes with open hostility. Some teachers fear the media as a threat to their jobs, some deplore them as a "de-personalization and automation" of the learning process, some simply are beset with anxieties about the new and unfamiliar. Students, too, refer to de-personalization and object particularly to the fact that they can not "ask questions" of movie screens, TV sets and teaching machines. McKeachie (1966) says of student attitudes toward new media: "They do not gladly embrace the new technologies. On the other hand, there does not seem to be substantial student resistance to innovations." Faculty attitudes, he says, tend to be more negative: "Except for the minority of faculty members who have been actively involved in preparing materials for and using the newer teaching media, faculty members seem to be distrustful of their value."[6]

Surveys of faculty and student attitudes toward instructional television tend to confirm McKeachie's general statement. Studies at Penn State, Miami, Iowa and other institutions indicate that administrators and television teachers are generally enthusiastic about televised instruction. Classroom teachers, particularly at the college level, are dubious; college students are generally opposed.

To date there seem to be no definitive studies of faculty attitudes toward programmed learning, although student attitudes seem on the whole to be favorable (G. W. Angell, (1947)[7] and Holland, (1959).[8]

Negative attitudes, particularly on the part of the faculty, can vitiate even the most admirably conceived instructional system. Student opposition can largely be overcome, as was demonstrated in an experiment conducted at the University of Denver (1966) which used a combination of televised instruction (transmitted to dormitories as well as classrooms) and small discussion sections. In this case student reactions, at the end of the experiment, were highly positive and in some cases genuinely enthusiastic. Attitudes of faculty members not associated with the experiment, however, were not perceptibly affected.

Finally, the traditional independence and separatism of the college teacher inhibits change of any magnitude in the college environment. Effective exploitation of media requires a relatively high degree of organization, integration and cooperation. Economic use of media requires a consistently high level of acceptance and use. Until faculties, by and large, are oriented to the use of media on a continuing level and within a coherent plan, technology has little chance of profitable employment as an important part of the formal college environment. This is not to say that technological communication will not in the future play a very large part in the total learning process which young people and old will use in their quest for knowledge and information and, hopefully, understanding and wisdom.

II. VARIOUS MEDIA AND THEIR CHARACTERISTICS

a. Books: The use of books, of course, is well established at all levels and in all kinds of education. Technology, however, does promise to have an increasing influence on how books will be used in college communities. Microfilm is already familiar to most students. Now microfiche promises further to decrease space needs of libraries and facilitate access to printed material.

b. Audio-visual devices are also familiar on most college campuses today. Tape recorders and slides, film strip or overhead projectors are relatively inexpensive, need no specialized personnel to operate, can be individually and economically programmed. Their use to this point, however, has been as teaching aids, rather than teaching methods, and they seem to offer little possibility of having any radical influence on traditional methods of instruction. Their advantages are well known: visualization of material, magnification of small objects, reproduction of visual materials, recording and reproduction of aural material. To date there is no evidence that, by themselves, they can contribute much to the large objectives of most technology in education, such as individualization of instruction, reduction of teaching time or classroom space needs.

c. Radio, so overshadowed by television for the past two decades, has only recently enjoyed a resurgence of interest among educators. The high hopes, in the 30's and 40's, for educational radio were never realized, but re-examination may bring out new uses for radio in college instruction. Small FM stations and wired wireless, provide a versatile means of communication with relatively small equipment costs (as low as $1000), and even lower costs for operation and programming. Radio's use for repeats

of lectures, reviews before examinations, and even two-way exchange for supplementary instruction, still awaits development.

d. Films, like radio, have recently been somewhat overshadowed by television. They are, however, so closely related with television, so easily integrated with and distributed by television, that the use of films in higher education has been consistently expanding. Film, like television, has the ability to magnify objects, to combine sight, sound and motion, to convey information on its own without the aid of a teacher, and to provide repeat showings. Like television it has the potential--theoretically at least--of replacing a teacher for some instructional functions. Unlike television, film can be utilized without large equipment outlays or expensive personnel for operation and maintenance of equipment. Also unlike television, it is readily adapted to individual instruction, through single concept films and cartridges for projectors, at relatively low cost.

With respect to the effectiveness of film as an instructional tool, research (Vander Meer 1950, 1951[9]; Hoban and Van Ormer, 1950[10]; Mertens, 1950-51[11]) has demonstrated that students do learn from films, at least as much as from poor teachers, that such learning includes not only factual material but concepts as well, and that, as students gain more experience with film instruction, its effectiveness increases.

The identification of good film material is always time consuming and its procurement can sometimes be expensive. Whether costs, in time and money, of using films for instruction can be recaptured from savings in teaching time depends chiefly on the care with which courses are designed and organized. In most actual cases, the use of film has tended to increase rather than decrease instructional costs.

e. Television, too, has tended more often than not to increase the costs of college instruction, although there have been some notable exceptions to this rule. It has been demonstrated by several institutions that where large numbers of students are involved ITV can reduce costs of instruction. Studies by Carpenter and Greenhill (1958),[12] Paden (1962)[13] and Seibert and Honig (1957)[14] generally agree that televised instruction begins to be less expensive than conventional instruction when at least 200-300 students are enrolled in a course. At the Chicago City Junior College (now Chicago City College) beginning in 1956 an entire two year program has been offered by broadcast television with consistent success. Precise figures are not available, but apparently the costs of televised instruction in this TV program compare favorably with those of regular classroom instruction. And at Penn State, the ITV project has been self-supporting since 1960, with TV enrollments now running at a level of about 13,000 students.

Both of these success stories come from large institutions whose extensive resources and large enrollments made it possible to invest large sums in equipment and technical personnel. The question remains whether less affluent institutions can possibly justify, economically or pedagogically, the use of television as a mode of instruction. It is to that question we must address ourselves now.

III. UTILIZATION AND INTEGRATION OF INSTRUCTIONAL MEDIA

In education, as in industry, the success of technology is directly dependent on the degree to which it is integrated with its total environment. Integration, in turn, depends upon precise design and comprehensive application. All of these factors have been conspicuously lacking in the great majority of efforts to use technology in our colleges and universities. Some of the reasons for this have been mentioned above: the diversity of American education, the decentralization of authority in our educational institutions, the resistance to innovation which seems to be characteristic of the academic temperament.

Despite these obstacles there have been some successful examples of systems design and application in American universities. Penn State and Chicago City College have already been cited. Others that have had more or less comprehensive media programs are Purdue, Iowa, Oregon, New York University, San Francisco State, Stephens College and the Air Force Academy. Two newly constructed colleges, Florida Atlantic and Delta, have incorporated into their structures elaborate dissemination and retrieval systems using virtually all media as a basic element of their curriculum. In general, however, Lewis Mayhew's statement about the experience of American education with technical innovation still applies: "After the experiments have been completed and reports written, the matter too frequently is dropped or is reinterpreted so as to leave undisturbed the slow waltz of lecturing, testing and grading which is the conduct of education."[15]

The examples of successful and durable use of technology in higher education have had, on the whole, several elements in common.

a. They have been funded by substantial grants or by institutions with ample resources to invest in experimentation.

b. They have had strong and continued support, at least on an experimental basis, from the institutions' administrations.

c. They have centralized the design and control of technical systems so as to integrate various devices and techniques (film, television, A/V and programmed learning) in one place: usually an independent Learning Resources or Instructional Devices Center.

d. They have been carefully designed, controlled and evaluated, with objectives and procedures clearly defined.

e. They have been accompanied by orientation programs for faculty and students to promote institutional acceptance and utilization.

f. They have been staffed by skilled technical and pedogogical personnel.

g. They have been versatile so that they could be adapted to many different kinds of situations.

With these elements in mind, what are the prospects for instructional technology in smaller colleges, vocational schools, junior colleges, where funds, staff and time are all at a premimum? How is the small liberal arts college with minimal resources to afford a "learning resources center?" How is a vocational school to support a staff of media experts, educational specialists, and researchers? How is a community college to design a technological plan which will be adaptable to its wide range of needs and objectives and its diverse student body?

No all-inclusive answers can be given to these questions; the answers will vary widely from institution to institution. There is no doubt, however, that means can be found for many of our smaller and less affluent schools and colleges to use technology to advantage. To be successful, however, they must:

a. Understand the limitations, as well as the possibilities of mediated instruction, not from the point of view of any one medium, such as television or teaching machines, but for whatever combination of media that will meet their specific and individual institutional objectives.

b. They must have access to and contact wi properly trained specialists in the design and operation of mediated programs and services. In the past few years, aided by government funds, a corps of such specialists is emerging from workshops and institutes all over the country.

c. They must analyze carefully the costs of instructional equipment, its maintenance, its operation and its programming, and insist that the technological operation be self-supporting. They must insure that technology be used as an alternate method of instruction, not as a supplement to or enrichment of traditional instruction. Thus the instructional systems design must be one in which a video tape or a film will be used in place of a lecture or discussion, a programmed sequence will be instead of a class meeting. It must break through the rigid pattern of thinking that has relegated virtually all instruction to classrooms, must regard the total college as the arena of inquiry--dormitories, lounges, union buildings, dining halls--and so mitigate the pressures for expanded instructional space and upkeep. Only in such a design can the labor saving potential of technology be realistically translated into economic advantage. But even thinking about such a concept may be difficult for anyone in a typical less affluent college.

d. Institutions must program their media with enough precision and imagination to enlist faculty support and student interest. Despite McLuhan's "the medium is the message" edict, what is put into and comes out of an instructional medium is the key to success or failure. This does not necessarily mean that mediated programs have to be lavishly produced. Color, music, elaborate visuals, all these expensive embellishments, have been found (Penn State and NYU) to have no positive effect on learning. Programs, however, do have to be painstakingly organized, clearly presented and carefully paced. Far too much of instructional television has been cluttered with fanciful techniques and whimsical diversions. Even more has been needlessly (albeit expensively) dull. With experience and with growth of tape and film libraries (Great Plains Tape Library, state libraries in New York and Pennsylvania) quality films and video tapes are becoming increasingly available and economical to use.

e. Inter-institutional cooperation must be increased.

Circulation is one of the keys to reducing the costs of mediated instruction. The cost of a computer used regularly by 10,000 students is not prohibitively high on a per unit basis. The cost of a well done film, with an audience of 20,000 students over a period of time can run less than $1 per viewing. With 100,000 viewings, that cost may go down to 20 cents. And if that film replaces the cost of direct instruction, true economies can be achieved. It takes ten colleges each with an enrollment of one thousand students to add up to a potential of 10,000 student users.

Users of commercial television evaluate their advertising messages on the basis of "cost-per-thousand viewers." Instructional television must learn to operate on the same scale. To do this, however, means

that smaller institutions must consistently and systematically share the costs of programs, of production and distribution facilities, of equipment procurement and operation. Clearly, cooperation on this scale is difficult in the academic world. Cries of "standardization," "centralization" and "sterilization" have already been raised and are bound to grow louder. Nevertheless, progress is being made in this direction, notably at the elementary levels, with an increasing number of school systems participating, in Chicago, Boston, Los Angeles County, Houston, the San Francisco Bay area, etc.

By this means, specialized skills are made available to large and small schools alike. The high capital costs of integrated media systems are brought within reach of the poorer along with the wealthier. Growing circulation exerts a steady downward pressure on per unit costs.

f. Institutions must be prepared to change traditional academic structures. Successful application of technology to industry has, of necessity, forced drastic changes in the industrial environment to accommodate that technology. Educational institutions must be willing to make similar changes in the academic environment if technology is to function effectively for them. As Lawrence Stolurow has said (1966): "the kinds of innovation that can survive when only superficial changes are made in the social context are those that represent only slight departures from the prevailing conditions."[16]

Clearly, the attainment of any one of these objectives represents a formidable task. Together, they may appear overwhelming. There are, however, a number of current developments that may make a comprehensive effort by educational institutions less difficult in the years ahead.

One of these developments is the introduction of simpler and less expensive hardware. A video tape recorder, for example, cost at least $50,000 ten years ago. Today, serviceable machines are available for around $1,000. Operating costs have been reduced commensurately. And the new recorders are simple enough for any student to operate after an hour or two of instruction.

The second development is facility sharing--for production of program material, for storage, for distribution.

A third development is the gradual change in faculty acceptance of new media as more teachers become familiar with them and the specters of technological unemployment and soulless mechanization are dissipated.

A fourth development is the increasing clamor for change in the methods and manners of college instruction, a clamor raised by faculty, as well as students and administrators.

A fifth is the emergence of a corps of competent media people in education, aware of the mistakes of the past, well grounded in media design and application.

The smaller and less affluent educational institutions no longer need feel excluded from the technological fraternity. On the contrary such institutions, often potentially more adaptable than some of their bigger sisters, more malleable and more easily redirected, readier to cooperate, more urgently pressed to increase efficiency and decrease cost, may well be in a position to lead the way in technological innovation. In their penetrating essay, "Educational Media, Education, and Society," (1966) Biddle and Rossi point out, "With appropriate use of new media,

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